CHAPTER 5

WATER POLLUTION CONTROL PROGRAMS

WATER POLLUTION CONTROL PROGRAMS

Point Source Control Program

Wastewater Treatment Facility Permitting

Point source pollution refers to any discharge from municipal or industrial facilities that can be identified as emanating from a discrete source such as a conduit or ditch. Kentucky has a total of 3,066 active permits covered by the Kentucky Pollutant Discharge Elimination System (KPDES) program. More than 4,700 additional coal mining-related discharges are covered under the KPDES Coal General Permit. Starting with the October 1992 EPA deadline for certain existing industrial stormwater sources, Kentucky has covered more than 1,600 facilities under eight new General Permits to date. EPA deadlines also required stormwater permit applications from two Kentucky metropolitan areas (Louisville and Lexington). The permits issued by the state for these areas mandate comprehensive pollution prevention planning programs augmented by system-wide stormwater monitoring.

The overflow from combined sanitary and stormwater sewers in excess of the interceptor sewer or regulatory capacity that is discharged into a receiving water without going to a publicly owned treatment works (POTW) is considered a combined sewer overflow (CSO). There are currently 341 CSO points statewide from 27 separate systems. Most of these are located on larger streams such as the Ohio River and Kentucky River. The state began to include permit language addressing CSOs in the summer of 1991 as permits expired and were reissued. Currently, eight permittees have permits reissued with CSO language included, and these eight permits cover 169 of the identified CSO points.

Section 104(b)(3) grants have been awarded to the Kentucky Division of Water (DOW) for CSO studies by the Metropolitan Sewer District in Louisville - Jefferson County and by the University of Kentucky's Water Resources Research Institute in the Northern Kentucky area. Water quality data specifically related to CSO events are being collected to determine the role of CSOs in water quality problems in the study area. This information, currently under review, will be valuable in developing a statewide database for tracking CSO trends and should facilitate future permitting and implementation strategies.

Wastewater permit limits in Kentucky have been water quality based since National Pollutant Discharge Elimination System (NPDES) program delegation on September 30, 1983. Generally, there are two approaches for establishing water quality-based limits for toxic pollutants: (1) chemical-specific limits, which are based on individual chemical criteria for all known toxic or suspected toxic pollutants in an effluent; and (2) whole effluent toxicity (WET) testing, which sets limits on an effluent's total toxicity as measured by acute or chronic bioassays on appropriate aquatic organisms. Both approaches have advantages and drawbacks, but when both are integrated into a toxics control strategy, they provide a flexible and effective control for the discharge of toxic pollutants.

Effluent Toxicity Testing

Toxicity data are available for only a limited number of compounds. Single parameter criteria often do not adequately protect aquatic life if the toxicity of the components in the effluent is unknown, there are synergistic (greater than predicted) or antagonistic (less than predicted) effects between toxic substances in complex effluents, or a complete chemical characterization of the effluent has not been carried out. Since it is not economically feasible to conduct exhaustive chemical analysis or determine the toxicity of each potentially toxic substance, the most direct and cost-effective approach to measuring the toxicity of complex effluents is to conduct whole effluent toxicity tests with aquatic organisms.

The DOW adopted an integrated strategy in 1988 to control toxic discharges into surface waters that included both chemical-specific limits and WET limits on certain KPDES permits. These limits were applied to most major and selected minor discharges with an approved pretreatment program. The WET limitations were developed for both acute and chronic levels based on a case-by-case evaluation of the discharge type and volume and the size of the receiving stream. WET is a useful complement to chemical-specific limits because it directly measures toxicity to aquatic organisms. It takes into account the aggregate toxicity in complex effluents and the chemical and physical interactions occurring in the effluent.

The DOW has implemented the WET limit into KPDES permits as a toxicity unit (TU). The TU allows acute and chronic toxicity to be reported numerically in the permit and on a discharge monitoring report (DMR) in order to determine compliance. Toxicity tests are conducted on a monthly basis for the first year of biomonitoring and quarterly in subsequent years. Test species are water fleas *(Ceriodaphnia dubia)* and fathead minnow *(Pimephales promelas)*. Acute tests are 48-hour static exposures. Chronic tests are the 7-day *P. promelas* growth test and the 7-day *C. dubia* reproduction test. Non-compliance with the acute toxicity limit is demonstrated if the LC50 (that concentration which causes 50% mortality in the test organisms) is less than the permit limit concentration. Non-compliance with the chronic limit is demonstrated if the IC25 (that concentration which causes a 25% reduction in growth or reproduction) is less than the permit concentration. Prior to 1993, compliance with a chronic limit had been based on a no observable effect level (NOEL).

During 1992 and 1993, toxicity tests were performed by the DOW at 38 municipal and 11 industrial wastewater facilities. Results of these tests indicated acute toxicity at 19 locations (39%) and chronic toxicity at 7 (14%) (Table 5-1). These effluent tests, in addition to several instream toxicity tests conducted on samples upstream and downstream of discharges, indicated potential impacts to portions of receiving streams in eight river basins.

The DOW has placed toxicity limits on 79 municipal and 40 industrial treatment facilities. Figure 5-1 and Table 5-2 show a breakdown of these 119 permits by facility type and toxicity limit.

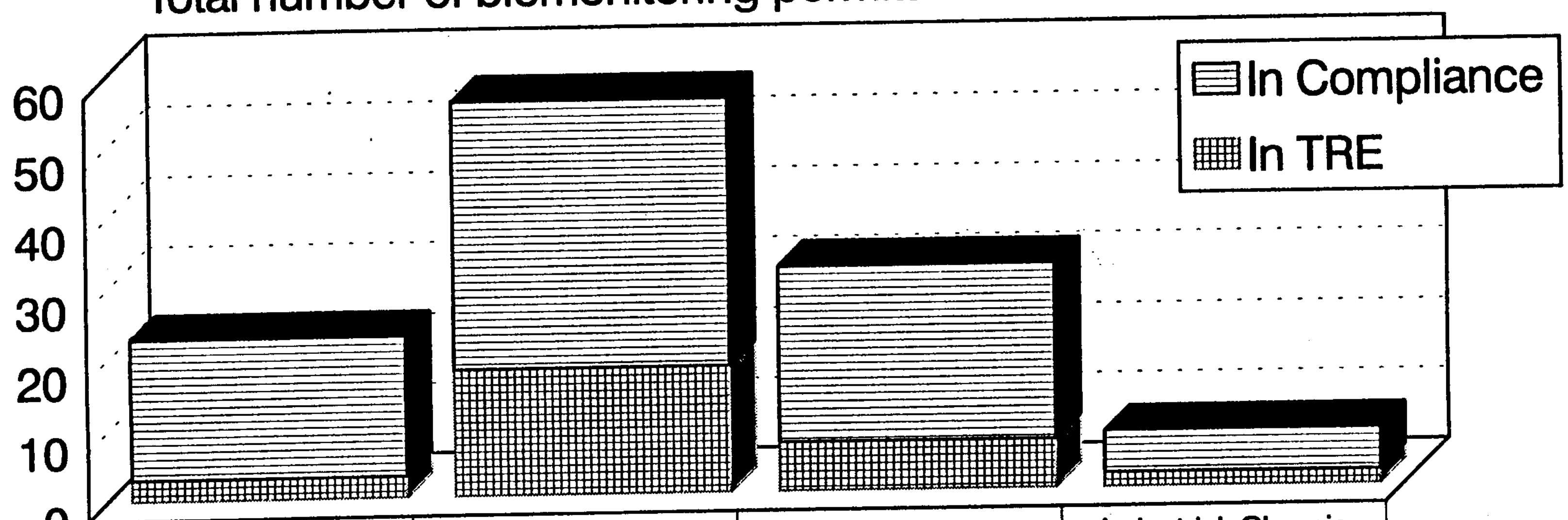
Table 5-1
Division of Water Effluent Toxicity Testing
1992-1993

FACILITY	TOXIC SITES	TOTAL TESTS	PERCENT TOXIC
	1992		
MUNICIPAL:			
MAJOR*	10	12	83
MINOR WITH PRETREATMENT**	0	1	0
MINOR***	2	6	33
TOTAL	12	19	63
INDUSTRIAL	1	5	20
	1993		
MUNICIPAL:			
MAJOR	9	13	69
MINOR/PRETREATMENT	1	6	17
MINOR	0	0	NA
TOTAL	10	19	53
INDUSTRIAL	2	6	33

*At least one million gallons a day
**Less than one million gallons a day and with a pretreatment program
***Less than one million gallons a day and with no pretreatment program

Figure 5-1: NUMBER OF BIOMONITORING PERMITS

BY FACILITY & PERMIT TYPE



	Municipal, Acute	Municipal, Chronic	Industrial, Acute	Industrial, Chronic
% Compliance	13	32	21	25
In Compliance	20	38	25	6
In TRE	3	18	7	2

Year-end 1993

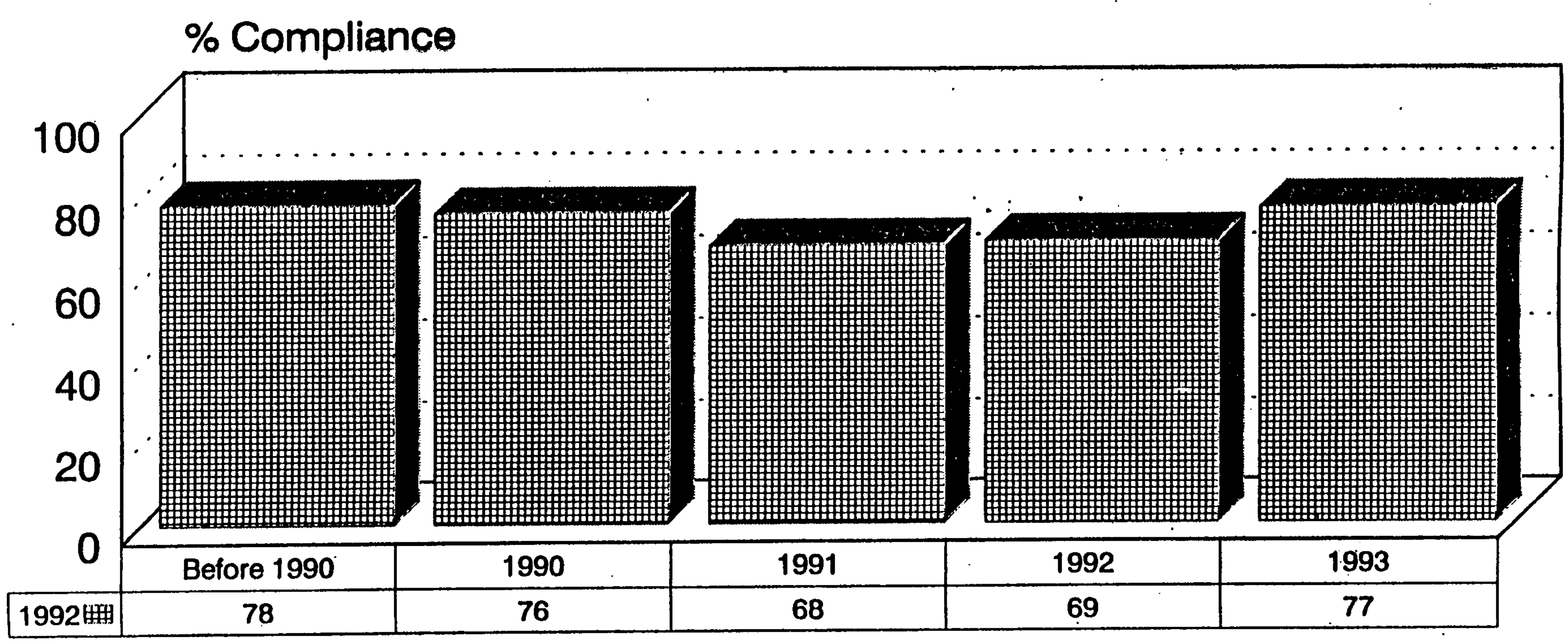
During 1992 and 1993, a total of 1731 tests were conducted by these facilities in accordance with KPDES biomonitoring permit requirements. The results showed 89 facilities (75%) met their toxicity limit (Table 5-2). Those not in compliance are conducting a toxicity reduction evaluation (TRE). The TRE is a step-wise process in which the operation of the facility is first evaluated and optimized. The effluent is then fractionated, if necessary, to determine what constituents are contributing to the toxicity and efforts made to eliminate these agents through source reduction or treatment optimization. Figure 5-2 shows the percentage of facilities in compliance since 1988. The percent compliance has remained relatively constant, ranging from 68% to 78% since the program started in 1988. However, as the number of KPDES permits with biomonitoring has increased over the years, the number of resolved TREs has also increased (Figure 5-3).

Table 5-2
Summary of Biomonitoring-Permitted Facilities at the End of 1993

	FACILITIES	TREs	% COMPLIANCE
INDUSTRIAL			
ACUTE	32	7	78.1
CHRONIC	8	2	75.0
MUNICIPAL			
ACUTE	23	3	87.0
CHRONIC	56	18	67.9
TOTAL	119	30	74.8

Ten facilities had completed TREs by the end of 1992, and a total of 14 were finished by the end of 1993. Thirty facilities (of a total of 119 with toxicity limits) are currently conducting TREs. The time needed to complete a TRE has ranged from eight months to four years and seven months. There are three facilities that have been in a TRE for more than five years. These facilities have not been able to determine a cause of their chronic toxicity.

Figure 5-2: BIOMONITORING COMPLIANCE*
BY YEAR



*Percent compliance is defined as facilities not in a TRE.

Figure 5-3: NUMBER OF TREs COMPLETED
BY YEAR

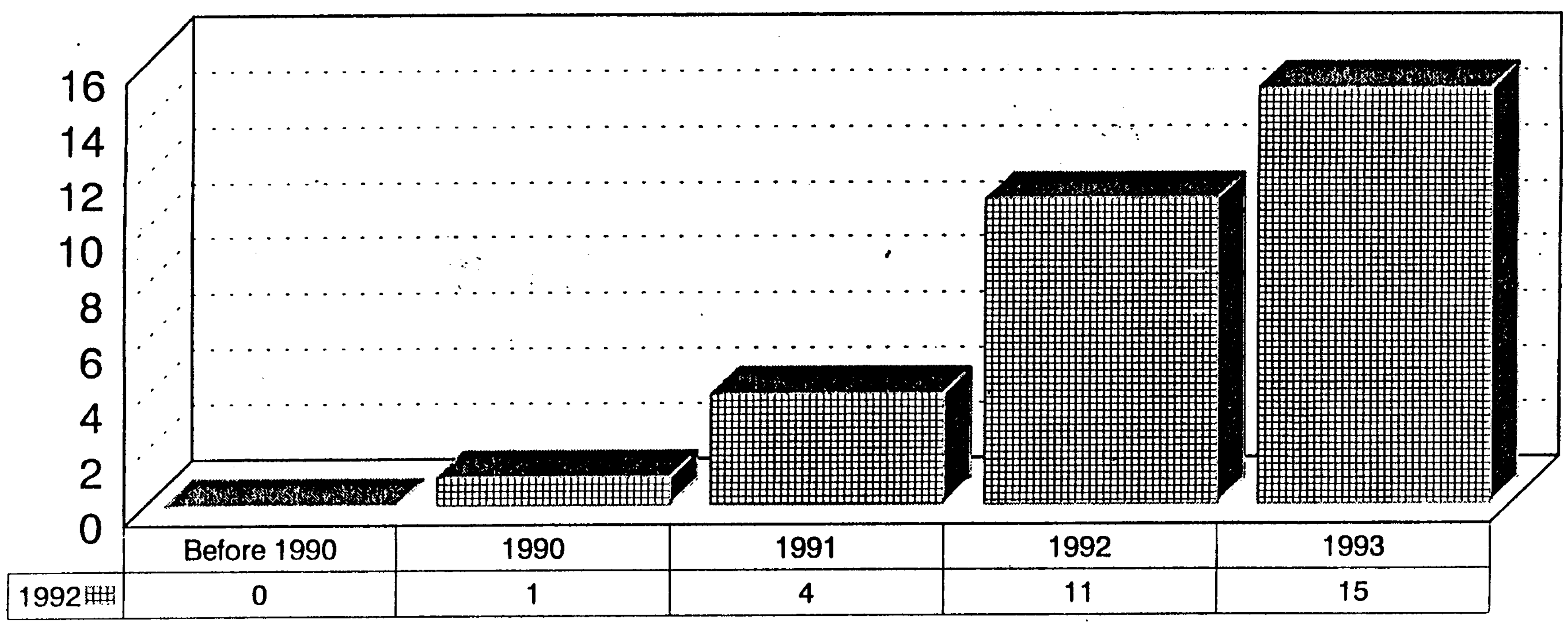


Figure 5-3 shows the progression of successfully completed TREs since 1990. The reduction of toxic discharges is being achieved through new treatment plant construction, plant improvements, plant operational changes, identification of new treatment options, removal of toxic sources, and enforcement of pretreatment program requirements. Construction and expansions of treatment plants were initiated primarily to deal with loading and capacity problems, but have had the added benefit of increasing WET compliance.

A close examination of the facilities in TREs has revealed that treatment type can play a significant role in the degree of toxicity in a discharge. Figure 5-4 shows how treatment type affects compliance with the biomonitoring limit. Considerable (119%) improvement in the compliance of Rotating Biological Contactors (RBCs) treatment plants has occurred with additional treatment such as oxidation ditches, resulting in less reliance on the RBC treatment technology. Optimizing plant operation and maintenance has also proven to be an important factor in reducing toxicity.

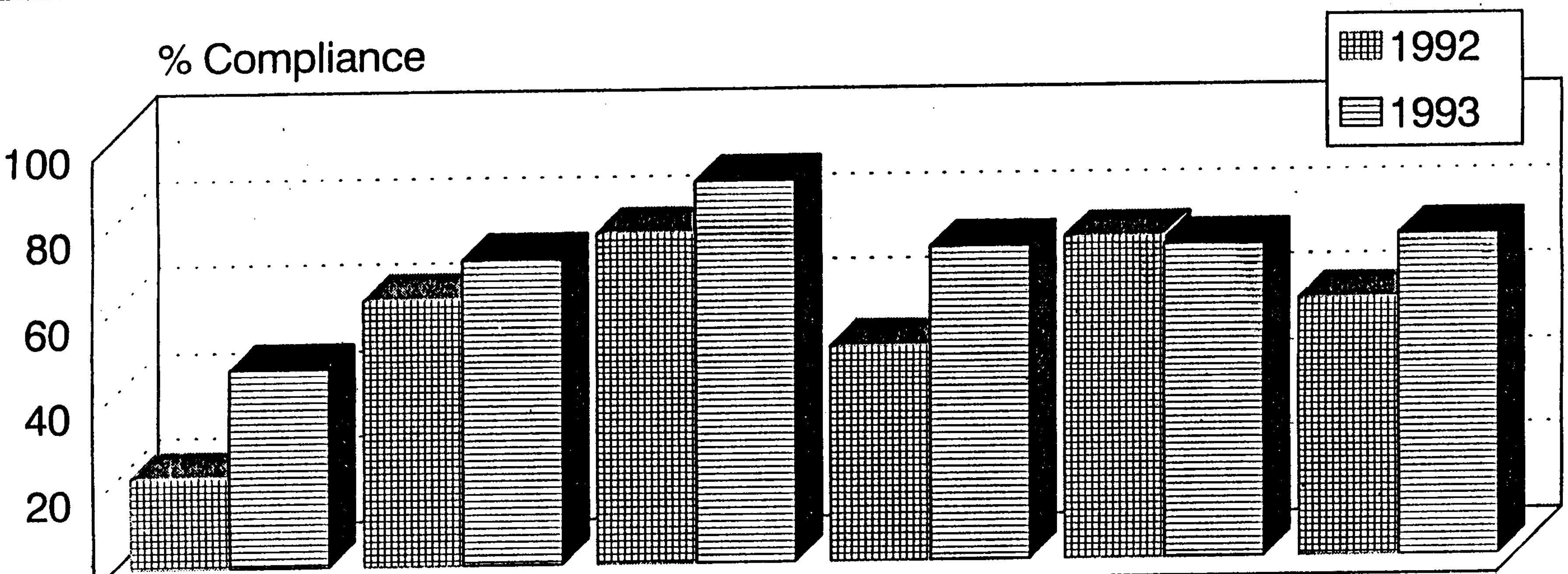
Toxicity identification evaluations (TIEs) have been performed on a number of facilities with varying success. The most commonly found groups of toxicants are metals and pesticides. It is becoming more apparent that the organophosphate insecticide Diazinon, commonly applied to lawns, turfs, and crops is a significant nonpoint source pollutant. There are a number of studies indicating that Diazinon levels reach or exceed the chronic and acute toxicity thresholds for aquatic organisms both in surface and groundwater (Table 5-3). Apparently, Diazinon is also a point source pollutant at some of Kentucky's KPDES-permitted municipal discharges. Based on limited data from TRE reports, Diazinon passes through wastewater treatment plants and enters receiving streams.

Table 5-3: Diazinon Ambient Data In Kentucky

Reference	Number of Detections	Number of Samples	Mean of Detections (ug/L)	95% Confidence Interval of Detections (ug/L)
Kentucky Division of Water 1992: Spring Data	4	126	0.18	0.04-0.20
STORET 1993: State of Kentucky	58	149	0.08	0.06-0.12
USGS 1992: Kentucky River	15	19	0.10	0.03-0.17

POTWs typically report more Diazinon-related toxicity during seasons of heavy pesticide use, i.e., April through September. Four facilities have confirmed that Diazinon contributes to their effluent toxicity by using the EPA Phase III TIE protocol (Mount & Anderson-Carnahan 1988). Other facilities have initiated daily monitoring of Diazinon levels in their effluents during 7-day chronic biomonitoring tests using a relatively inexpensive enzyme-linked immunosorbent assay kit (ELISA). Based on limited data, levels of Diazinon appear to correlate ($r=0.89$) with effluent toxicity and coincide with the pesticide application season, especially August and September.

Figure 5-4: BIOMONITORING & TREATMENT TYPE



	RBC	Activate Sludge	Ox. Ditch	Ext. Aeration	Trickling Filter	Lagoon
1992	21	62	77	50	75	60
1993	46	71	89	73	73	75

*Percent compliance is defined as facilities not in a TRE.

The 96-hour acute toxicity level of Diazinon to *Ceriodaphnia dubia*, the most commonly used biomonitoring species, is 0.2 ug/L. Approximately 34% of the daily samples analyzed for Diazinon exceeded this 96-hour acute toxicity threshold. A summary of Diazinon data associated with biomonitoring at seven POTWs is presented below in Table 5-4.

Table 5-4: Diazinon Discharge Data In Kentucky

Total Number of Samples	48-hr Acute Toxicity Level (ug/L)	Percent (%) Above 48-hr Level	96-hr Acute Toxicity Level (ug/L)	Percent (%) Above 96-hr Level	Mean (95% C.I.) (ug/L)
134	0.4	21	0.2	34	0.28 (0.21 - 0.36)

A number of questions remain unanswered related to Diazinon toxicity in Kentucky waterways and WWTPs. Issues for which data are being collected include: (1) the extent of the problem; (2) the persistence of this insecticide compared to other pesticides; (3) the reasons some facilities can effectively treat the pesticide and others cannot; (4) the current treatment efficiencies for Diazinon; (5) the mode of entry of Diazinon into the WWTP collection systems; and (6) the instream effects resulting from Diazinon discharges and runoff. The DOW continues to work with municipalities to determine the extent and sources of Diazinon entering waterways and collection systems and its role in toxicity.

Pretreatment Program

The quality of Kentucky's surface waters continues to face a threat from improperly treated industrial waste discharged into municipal sewage treatment systems. Such waste often contains pollutants that are either not removed by the municipal treatment process or, if removed, result in the generation of contaminated sludge. In an effort to control this problem, Kentucky has approved pretreatment programs in 71 cities (64 active, 7 inactive as of February 1994) and has screened several others to determine their need for a pretreatment program. During the period covered by this report, new programs have been approved and implemented in Morganfield, Shepherdsville, and Wurtland. A list of communities with approved pretreatment programs and the estimated costs to administer the local program is presented in Table 5-5. The facilities needing programs are all on schedule for obtaining approval. Once approved, each program is inspected annually and must submit semi-annual status reports to the DOW for review. These reports are incorporated into the computer files known as the Permit Compliance System (PCS) and Pretreatment Permits and Enforcement Tracking System (PPETS). Kentucky was recognized by U.S. EPA in 1991 and 1992 for achievements in its use of the PPETS program.

Table 5-5
Total Estimated Level of Annual Funding Required to Implement the POTW Pretreatment Program

No.	POTW	$/Year
1	Adairville	15,000
2	Ashland	90,844
3	Auburn	15,000
4	Bardstown	20,000
5	Beaver Dam	5,000
6	Berea	7,000
7	Bowling Green	52,200
8	Cadiz	INACTIVE
9	Calhoun	INACTIVE
10	Calvert City	5,000
11	Campbellsville	46,410
12	Campbell/Kenton SD #1 *	132,000 *
13	Caveland Sanitation	14,880
14	Corbin	68,046
15	Cynthiana	8,000
16	Danville	13,000
17	Edmonton	INACTIVE
18	Elizabethtown	350,000
19	Elkton	1,000
20	Eminence	22,500
21	Flemingsburg	9,000
22	Frankfort	40,000
23	Franklin	32,000
24	Fulton	18,000
25	Georgetown	12,000

Table 5-5 (Continued)

No.	POTW	$/Year
26	Glasgow	22,600
27	Guthrie	7,000
28	Harrodsburg	15,000
29	Hartford	6,260
30	Henderson	24,800
31	Hopkinsville	151,000
32	Jamestown	20,000
33	Lancaster	1,000
34	Lawrenceburg	22,500
35	Lebanon	10,000
36	Leitchfield	35,895
37	Lexington	161,600
38	Livermore	5,506
39	London	15,000
40	Louisville	1,705,600
41	Madisonville	32,000
42	Marion	INACTIVE
43	Mayfield	12,500
44	Maysville	9,000
45	Middlesboro	15,000
46	Monticello	8,000
47	Morganfield	1,500
48	Morgantown	30,000
49	Mt. Sterling	13,500
50	Murray	20,000
51	Nicholasville	15,000
52	Owensboro	61,000
53	Owingsville	INACTIVE

Table 5-5 (Continued)

No.	POTW	$/Year
54	Paducah	78,000
55	Paris	10,000
56	Princeton	18,000
57	Richmond	16,562
58	Russellville	14,900
59	Scottsville	INACTIVE
60	Shelbyville	19,180
61	Shepherdsville	19,000
62	Somerset	21,852
63	Springfield	6,000
64	Stanford	2,000
65	Tompkinsville	INACTIVE
66	Versailles	1,000
67	Williamsburg	15,000
68	Williamstown	4,500
69	Winchester	30,000
70	Wurtland	10,000
	TOTAL	$3,664,135

* Includes South Campbell County (County Fiscal Court)

Kentucky assesses pretreatment program effectiveness by reviewing wastewater sludge quality for five heavy metals: cadmium, copper, lead, nickel, and zinc. Sludge quality has shown continuous improvement in the 1984-93 period.

The National Pretreatment Excellence Awards recognize those publicly owned wastewater treatment plants that have developed and implemented effective and innovative pretreatment programs. EPA's award program was divided into four categories based on flow of the POTW: 0 to 2.0 MGD, 2.01 to 5.0 MGD, 5.01 to 20.0 MGD, and greater than 20 MGD. These categories have been changed to ones based on the number of significant industrial users (SIUs) served: 1-10, 11-20, 21-50, and greater than 50.

With the beginning of the awards program in 1989, Kentucky POTWs have fared well, with a total of five programs receiving the awards:

Year	POTW	Category
1989	Louisville MSD	(20 + MGD)
1990	Bardstown	(0 - 2.0 MGD)
	Richmond	(2.01 - 5.0 MGD)
1991	Leitchfield	(0 - 2.0 MGD)
-	Corbin	(2.01 - 5.0 MGD)

Municipal Facilities

Construction grants, state revolving loan fund monies, and other funding programs have resulted in the construction of more than $64 million in wastewater projects that came on line during 1992-1993 as indicated in Table 5-6. Twenty-six municipal wastewater projects were completed during this two year period. An additional 25 projects are in various stages of construction.

Although significant improvements in water quality have been realized through the construction of new wastewater treatment facilities, there are numerous needs that remain to be addressed. The 1992 Needs Survey, conducted by the DOW as part of its facilities planning process, indicated that municipal discharges continue to impair water quality and pose potential human health problems. State and federal minimum treatment requirements are not being met in every instance. The 1992 Needs Survey identified a capital investment need of $1.516 billion to construct and rehabilitate wastewater treatment facilities and components for Kentucky, based on the 1990 population. Backlog needs of $1.516 billion, coupled with long-range needs for publicly owned treatment facilities, reveal a projected total

Table 5-6. Wastewater Treatment Facilities That Came on Line During Calendar Years 1992 - 1993

Type of Funding/City	Date on Line	Design Flow (mgd)	Treatment Cost	Interceptors Cost
Loan				
Bowling Green	12/01/92	8.40	6,669,000	368,000
Bowling Green	06/18/93	-	226,000	198,000
Boyd Co. Fiscal	07/19/93	-	2,463,000	1,326,000
Brandenburg	07/28/93	0.19	1,931,400	0
Butler	05/15/93	0.14	383,850	0
Campton	04/29/92	0.10	592,775	0
Cumberland	09/24/93	0.50	1,222,700	144,000
Elizabethtown	08/12/93	7.20	8,453,000	0
Georgetown	10/28/93	2.34	6,009,300	0
Greenup	10/29/93	0.20	218,650	152,000
Lewisburg	02/10/93	0.35	622,091	0
London	12/17/93	4.0	3,124,495	4,024,010
Mayfield	07/30/92	3.10	3,719,000	0
Melbourne	12/10/93	-	916,090	0
Middlesboro	12/16/93	2.80	0	832,085
Pikeville	02/18/92	2.00	2,700,000	0
Providence	12/02/92	0.63	3,795,000	0
Reidland	01/06/93	-	0	1,847,500
Southshore	06/01/93	0.39	2,769,000	0
Williamsburg	11/15/92	0.80	1,024,110	0
Total			**46,839,961**	**8,891,595**
Grant				
Benton	03/31/92	1.00	181,333	0
Bradfordsville	01/25/93	0.04	940,904	0
Caveland (Hwy 70/I 65	12/26/92	0.50	0	746,340
Estill Co.	01/07/93	0.21	3,135,794	0
Franklin Co.	02/01/93	-	754,539	0
Hardin	09/30/92	0.10	362,331	0
Oak Grove	12/10/92	-	0	3,014,453
Total for EPA Funded Projects			**5,374,901**	**3,760,793**

need of more than $2.391 billion through the year 2012. EPA estimates that $1.090 billion of this money will be needed for nonpoint source control projects. A detailed breakdown of investment needs is presented in Table 5-7.

Table 5-7
Investment Needs for Wastewater Treatment Facilities in Kentucky 1992-2012
(In millions of January 1992 dollars)

Facility	For Current 1992 Population	Projected Needs 2012 Population
Secondary treatment	$270	$203
Advanced secondary treatment	59	35
Infiltration/Inflow	77	79
Major rehabilitation of sewers	20	19
New collector sewers	667	586
New interceptor sewers	391	348
Correction of combined sewer overflows	32	31
Nonpoint Source	0	1,090
Total	$1,516	$2,391

Kentucky has operated the state revolving loan fund (SRF) for five years. Forty-eight projects have been funded to date, committing $111 million in SRF money and totalling $137 million in project costs. Project costs have averaged $2.3 million, and have ranged from $178,085 to $10,890,000.

The SRF is proving to be a popular funding program for publicly owned wastewater treatment facilities. With interest rates ranging from 0.4 to 4.3%, the SRF is used for funding complete projects as well as to supplement grant-funded projects.

The funding formula for allocation of capitalization grants for SRF loans provides that Kentucky will receive 1.2872 percent of the authorized amount. This figure falls short of Kentucky's fair share whether compared on a needs or a population basis. A funding allotment percentage for Kentucky of approximately 1.55 percent would be more in line with needs and population figures. The estimated annual difference in available state revolving fund money would translate into two or three additional wastewater projects for Kentucky communities. A change in the allotment is being considered by Congress.